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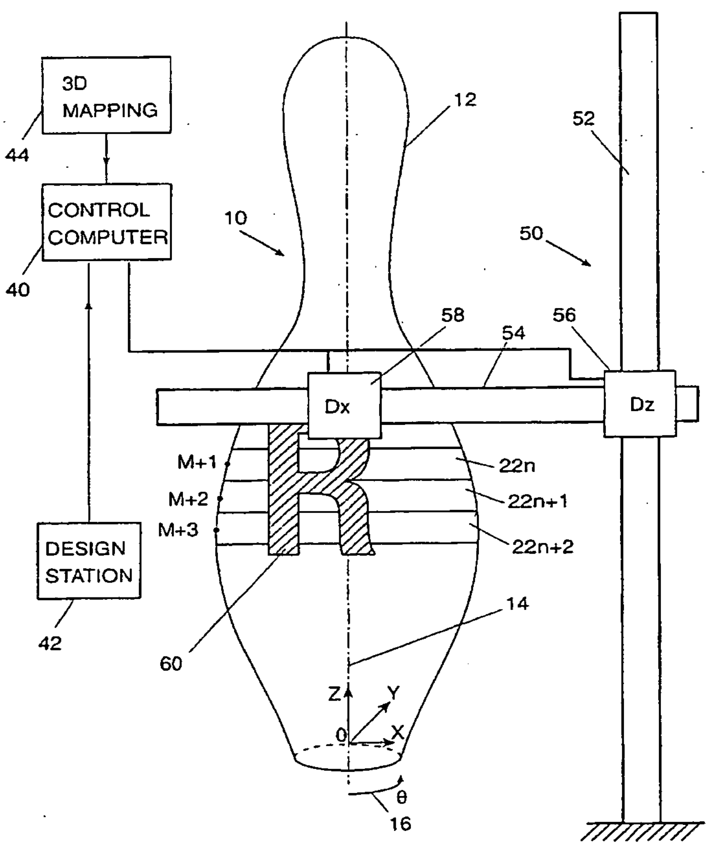
(54) Title: CONTINUOUS FLOW INKJET UTILIZED FOR 3D CURVED SURFACE PRINTING



(57) Abstract: A system and method for printing images on curved surfaces (12) of 3D objects (10) such as bowling pins or beverage bottles, the system comprising a digital representation of the 3D surface of the object, inkjet printing heads (58) capable of covering a predetermined strip (22n) of the surface, a digital representation of the image to be printed on the surface, means for positioning the printing heads relative to the printable surface, means for rotating or translating the object, to enable the printing operation and a control system coordinating, calculating and operating the required tasks.

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CONTINUOUS FLOW INKJET UTILIZED FOR 3D CURVED SURFACE PRINTING

FIELD AND BACKGROUND OF THE INVENTION

The present invention relates to inkjet printing on 3D curved surfaces, and particularly to curved surfaces as presented in bowling-pins, bottles, and art objects.

The invention is useful in color printing of 3D symmetrical or non-symmetrical objects having mostly curved surfaces, such as for example bowling-pins, and other 3D objects such as plastic beverage bottles having partly cylindrical surfaces and partly curved surfaces.

While direct color printing on rigid cylindrical objects is possible, such full color printing on the cylindrical part of plastic bottles is impractical and therefore labels are used presently instead, said labels preprinted and attached to such surfaces. Labels are attached also to the conical parts of bottles. The use of labels for bottles of all kinds dictates usually printing of such labels in quantities, while "on-demand" printing, where content of the label changes frequently, is impractical. In contrast, "on demand" printing is used frequently in flat material printing (brochures, outdoor publicity), printed by a variety of methods such as xerography, offset and inkjet.

Inkjet printers are generally divided into drop-on-demand (DOD) and continuous-flow CF.

DOD inkjet printing heads are characterized by the ability to control the ejection of each drop at the source, while in CF inkjet heads the control of a continuous stream of charged ink drops is done by an electrostatic field acting on the stream of charged ink droplets.

Due to technical constraints it was found that inkjet printing is the best solution for printing on curved surfaces, particularly due to the fact that inkjet printing requires no contact with the target surface.

A number of patent documents cover the technology of inkjet printing on cylindrical or curved surfaces: EP0209896, JP05-293955, US 6,135,654, JP07-052525, EP0620117, EP0970811, JP02-128774, JP05-318715, JP2001-315316, WO97/27053.

Modern production facilities, including printing or labeling, require high throughput, combined with good color print quality. These constraints applied to, for example, bottles or golf pins call for new solutions, based on up-to-date technology.

BRIEF SUMMARY OF THE PRESENT INVENTION

According to one aspect of the present invention there is provided an apparatus for inkjet printing on objects having curved surfaces, in particular symmetrical objects such as, for example, bowling-pins or plastic beverage bottles. The apparatus comprises means for obtaining the surface coordinates of the 3D object, in particular those surfaces on which printing will take place. Such means include for example known in the art 3D scanners or the design file of said object, as created on a CAD system. The printing means defined in the invention includes inkjet heads, capable of covering a surface strip of a predefined width. Such heads are known in the art of DOD or CF inkjet devices. The invention is described with reference to an exemplary 3D symmetrical object and known in the art type of CF inkjet heads, which can be mounted in a staggered fixed pattern to cover a specific printing surface, or alternatively on a "robotic" X-Z arm. In both configurations the inkjet head can move in and out towards the surface of the object and tilt to a position, which is preferably parallel to the midline of the active strip. By rotating the object, for example, around its Z-axis, printing can be performed on the specific strip. According to further features of the invention a control system is described, which receives the image file to be printed from a local design station or from a remote data source, as well as the related surface coordinates from the specific data source. The control station calculates the required positioning of each printing head and coordinates the rotation of the object with the operation of the inkjet head to accomplish color printing of the desired image on the specified surface of the object.

To demonstrate the sequence of operations required for printing an exemplary flow diagram is shown, detailing the tasks starting with 3D mapping and going through all the required operations up to printing.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is herein described, by way of example only, with reference to the accompanying drawings, wherein:

Fig. 1. Schematically illustrates an object having curved surfaces, on which the invention will be applied;

Fig. 2. Schematically illustrates the method of staggered inkjet printing heads as applied to the object of Fig. 1;

Fig. 3. Schematically illustrates a side-view of an inkjet printing head of Fig.2 as positioned at a predetermined distance and parallel to the tangent to an arbitrary point on the curved surface;

Fig. 4. Schematically illustrates the 3D mapping, design and control modules required for the operation of the printing system of Figs. 2 and 3;

Fig. 5. Schematically illustrates the "robotic" inkjet printing method as applied to the object of Fig. 1;

Fig. 6. Schematically illustrates the 3D mapping, design and control modules required for the operation of the printing system of Figs. 5; and

Fig. 7. Schematically illustrates the workflow required for the application of the invention embodiments as described.

DESCRIPTION OF PREFERRED EMBODIMENTS

The invention will be described, as an example, with respect to a bowling–pin 10 of Fig. 1, being a symmetrical object having mostly curved surfaces, except for the bottom part. Axis 14 is the symmetry line of the bowling-pin 10 around which it can be rotated by an angle Θ 16. The surface 12 of the bowling pin can be described as a sum of equally-wide stripes 22, each of a width ΔW, divided horizontally, namely perpendicular to symmetry axis 14. The curvature at each middle point M of an arbitrary strip 22n can be measured by the tangent 24 to that point, and if the width ΔW is small enough, the curvature can even be defined by that tangent line.

Color printing on stripes 22 can be performed, for example, by inkjet heads such as described in patents no. US 5,940,099 (DOD inkjet array),US 5,969,733, US 6,003,980, or US 6,106,107 (CT inkjet multi drop).

Taking for example an existing inkjet head as offered by Jemtex Ink Jet Printing Ltd. of Lod, Israel, which operates according to the principles described in said US '733, US '980, US '107 patents. Such a printing head can print a color image on an 8mm wide strip with resolutions better than 100 DPI (Dots Per Inch). According to the principles of operation described in US 6,003,980 the printing dots can be controlled and equally placed on the curved surface (up to specified limits) around middle-point M of strip 22n, provided the curvature is known around that point.

Mapping the surface 12 of bowling-pin 10 can be achieved, for example, by 3D scanners or by having access to a CAD design file of this object.

For the discussion of the mapping phase required by this invention, an XYZ coordinate system is shown in Fig.1 with its zero point in the middle of the bowling-

pin's base . The mapping of bowling-pin 10 can be done, for example, by one of the following known in the art methods:

a) CAD design: objects, such as the bowling-pin 10, are frequently designed by CAD systems. In this case the object surface can be divided into stripes of equal width ΔW and the curvature around each middle-point M (Xn, Yn; Zn) can be defined and logged. Obviously, if the object 10 is symmetrical around axis 14, this type of calculation is done only for the points Mn along the contour line of the object.

b) 3D scanning: using scanners such as LPX-250 3D Laser Scanner by Roland DGA Corporation of Irvine, Cal. USA, or VIVID 900 by Minolta USA, Instrument Systems Division of Ramsey N.J USA, the entire surface, or the surface around the contour line for a symmetrical object, can be digitized at a high resolution and accuracy and the results subsequently translated by known in the art methods into an accurate log of the contour line and related curvature, namely the collection of mid-points Mn and the related curvature at each point.

Four preferred applications will be described, as an example:

A. The static staggered printing head method.

This preferred embodiment employs, for example, Jemtex inkjet heads of the type described above, each for one of CMYK inks to achieve color printing. Such a CMYK inkjet printing head is marked 30 in Figs. 2 and 3. In the static printing head method the coverage of the entire effective printing surface 12 of the bowling–pin 10 requires staggering of the heads 30 as basically shown in Fig.2, to enable practical and precise coverage of the surface. Other staggering schemes than shown in Fig.2 can be used, including use of single color heads in various configurations or

separation of the process into four printing stations as done in offset printing. The following technical discussion holds for four-color heads as shown in this example or for single color heads, which may be used in other staggering configurations,

The printing heads 30 are mounted on a static structure (not shown), as known in the art, around the object 10, with proper ability to displace each printing head 30 with precision in the XYZ directions plus rotating each head around its long axis 32, as shown in Fig. 3, the axis being parallel to the X-Y plane. The purpose of this displacement and rotation is to bring the head 30 to a position where its short axis 34 is parallel to the tangent 24k and its effective inkjet ejection middle is at a distance Hk 36 from the middle Mk of strip 22k, this distance Hk being best suited for the inkjet operation of head 30. In this position each printing head can be best calibrated and controlled to place the ink dots in their proper place, in spite of the curvature of object 10.

Assuming in this example that each individual printing head 30 covers a strip 22, the object 10 is rotated around axis 14 at a precise rate conforming to the specifications of head 30, to enable effective printing on the entire surface 12, or more practically on every part of surface 12, which is to be color printed according to the design required by the specific job.

Image print accuracy can be calibrated, as explained in US ' 980, by printing a "line", which conforms to the contour of object 10. Other methods of staggering the ink jet heads will require different methods of calibration, provided the end result is to assure placement of ink dots on the curved surface as if the surface was flat.

Control of the static printing heads is done from a central computer 40 of Fig.4, having in its storage means the control files related to the simultaneous print operation of all heads 30 participating in a specific job, the synchronized rotation of

object 10 around its axis 14, as well as the data files related to the color image to be printed in the same job. This control scheme is based on known in the art techniques. The adjustment of the individual heads 30 as described, can be done by any know in the art manual or electromechanical means.

The control diagram, shown in Fig. 4, depicts schematically the control computer 40 linked to the adjustment means of printing heads 30. This computer 40 receives the mapping results of object 10, pre-prepared by unit 44, as described above. The mapping results are essential for the proper adjustment of printing heads 30 at each point Mn of the surface to be printed.

The specific image to be printed on object 10 is prepared in design station 42, or alternatively transferred by any known communication means from distant design stations (not shown). This is a known in the art practice. The static staggered head printing method requires a fairly complicated structure, numerous printing heads, and an elaborate head adjustment method but enables a fast print coverage of the object surface 12. This can be an advantage in production lines, where productivity is of major importance.

B. The "robotic" printing method.

This second preferred embodiment, shown in Fig. 5 employs, for example, Jemtex inkjet heads 30 of the type described above, mounted on a known in the art robotic device 50 having motorized means Dz 56 to move the horizontal X rail 54 in a precise way along the vertical Z rail 52. Another motorized unit Dx 58 can move in a precise way along the horizontal X rail 54. Unit 58 carries at least one Jemtex CMYK inkjet printing head 30, as described above, said printing head (not shown), mounted on a precision motorized pedestal (not shown), can do the following:

a) tilt the printing head 30, as described in Fig.3, to bring the short (?) axis 34 to be parallel to tangent 24k at point Mk.

b) move the printing head 30 in or out to bring the effective center to a distance Hk from the surface at point Mk.

The operation of the “robotic” printing method is based on a combined rotation of object 10 around axis 14 at a precise rate conforming the specifications of head 30, and displacement of head 58 in the X and Z directions, to enable effective printing on the entire surface 12, or more practically on every part of surface 12, which is to be color printed according to the design required by the specific job.

The control diagram, shown in Fig. 6, depicts schematically the control computer 40 linked to the motorized units 56, 58 and the precision pedestal on which at least one printing head 30 is mounted (not shown). This computer 40 receives the mapping results of object 10, pre-prepared by unit 44, as described above. The mapping results are essential for the proper positioning and adjustment of printing heads 30 at each point Mn of the surface to be printed. Control 40 is responsible for the pre-programmed combined rotation and displacement scheme as described above.

The specific image to be printed on object 10 is prepared on design station 42, or alternatively transferred by any known communication means from distant design stations (not shown). This is a known in the art practice.

The robotic method is more flexible and demands less printing heads, but the time to cover a specific print area will be higher.

The robotic method and apparatus have another advantage, namely accommodating for the 3D scanners as described. The X-Z rails may be used for the scanning application, combined with rotation of object 10 around axis 14, to 3D map

the surface 12, or in case of a fully symmetrical object, as shown in this example, only a contour line and the surrounding surfaces. This option will be further discussed in par. D.

C. The hybrid static-robotic method of printing.

The systems described above can be combined, by using the static staggered heads to cover part of the surface while the robotic head covers another part, both systems operating simultaneously. This might have advantages in certain applications where speed and flexibility are at premium.

D. The "robotic" method of printing including "look ahead" 3D scanner.

This technology combines a 3D scanner and a printer head in one movable assembly as basically described in par. B above. The scanning device is positioned to "looks ahead" on the rotating object 10, enabling measurement and calculation of the distance and curvature information of surface 12 lying ahead of the printing area, while the printing head adapts itself to those constraints for optimum printing results.

It must be emphasized that printing methods A, B, C and D are not limited to axis 14 symmetrical objects 10, but also apply to non-symmetrical objects 10, provided the objects can be rotated around axis 14 to facilitate the printing operation.

The method of application of the described printing systems

Fig. 7 describes the sequence of operations required to accomplish color printing on the surface of objects having curved surfaces, according to the present invention.

Step # A. 3D Mapping by unit 44: task 80 includes a one-time preparation of the data related to the surfaces defined by a specific job to be printed on object 10. Alternatively the entire surface 12 of same object 10 is 3D mapped at high resolution and the resultant file is stored for all future printing jobs defined for the same object.

Step # B. The design of the image for the specific job is prepared in task 90 on station 42, imported via the Web or otherwise received by a portable storage device.

Step #C. The data measured in task 80 is transferred to the control-computer 40 for calculation in task 82 of the coordinates, tangent and curvature at defined surface points Mn, conforming to the design to be printed on specific surface areas of object 10 as prepared in task 90.

Step #D. task 84; the data file of the coordinates, tangent and curvature at points Mn is loaded into the head control module (not shown) of control 40.

Step #E. task 86; according to the type of printing method present in the system (staggered heads, robotic, etc.), the image to be printed prepared in step 90 and the data file prepared in task 84, the positioning of the at least one printing head 30 is calculated, as well as the movement scheme for the driving motors (for the robotic option).

Step #F. In step 92 the adjustment of the printing head/s 96 and movement of the driving motors 98 is coordinated with the rotation 94 of object 10 around its axis 14 to accomplish printing in task 100.

Step #G. The printing in stripes 22 of the image to be printed is accomplished by the print control task 102.

Other preferred embodiments

The embodiments described above are based on the division of the useful print surface 12 into equal width strips 22. The same applications can be used for strips 22, which are not equal in width ΔW, for example narrow strips disposed next to wider strips. Smaller width strips can be used, for example, for higher resolution of the inkjet dots on surface 12 or higher coverage and rotation speed of object 10.

Other changes can involve printing head 22 positioning at an angle to the tangent 24, instead of being parallel.

Certain beverage bottles have a square "body" instead the more common "cylindrical" body. Such "square" beverage bottles can be printed by the devices described above, with the exception that in the static staggered head structure an additional relative movement is required to allow printing on the flat facet, while the rotation of the object is used to bring a new facet under the printing mechanism. The "robotic" printing system is better adapted to cope with a "square body" object, though slower in throughput.

While the invention has been described with respect to several preferred embodiments, it will be appreciated that these are set forth merely for purposes of example, and that many other variations, modifications and applications of the invention may be made.

WHAT IS CLAIMED IS:

1. A system for inkjet printing of an image on a 3D object having curved surfaces, said system comprising:

digital representation of the 3D surface of said object;

at least one inkjet printing head capable of covering a predetermined strip of said surface;

means for positioning said at least one printing head in relation to said strip;

means for rotating said object around a predetermined axis;

a digital representation of said image to be printed on the surface of said object, and

a control system, said control system enabling the coordinated operation of said printing head positioning, said rotation and said printing of said image.

2. The system of claim 1, wherein said digital representation of the 3D surface determines the digital coordinates of every given point on the surface of said object.

3. The system of claim 2, wherein said digital coordinates can be obtained from one of 3D scanning of said object and the digital design file of said object.

4. The system of claim 1, wherein said at least one inkjet head can be one of a multi-jet CF inkjet head and a DOD multi-nozzle array.

5. The system of either of claims 1 or 4, wherein the width of said predetermined strip depends on characteristics of said inkjet head.

6. The system of claim 1, wherein said at least one printing head are structured in one of a “staggered”, “robotic”, “hybrid” and “look ahead” methods.

7. The system of claim 1, wherein said positioning is based on data obtained from said digital representation of the 3D surface.

8. The system of claim 1, wherein said rotation enables said printing operation of said image on said surface.

9. The system of either of claims 1 or 8 wherein said predetermined axis is a 3D symmetry line.

10. The system of claim 1, wherein said digital representation of the image is obtained from one of a local design station and an imported data file.

11. The system of claim 10, wherein said imported data file is received by one of transportable storage medium and communication link.

12. A method of inkjet printing of an image on a 3D object having curved surfaces, said method comprising:

providing the digital representation of said image to be printed on said object;

providing the digital coordinates of at least the printable surface of said object;

calculating the tangent and curvature of at least one point on said printable surface;

loading the result of said calculation into a control computer;

positioning at least one inkjet printing head;

rotate said object to accomplish printing of said image in stripes by said printing head on said printable surface.

13. The method of claim 12, wherein said providing the digital representation of said image includes one of creating the image on a local design station and importing the image.

14. The method of claim 12, wherein said providing the digital coordinates includes one of 3D scanning of said object and providing a digital design file of said object.

15. The method of claim 12, wherein said calculating includes determining the print resolution and image coverage of said surface.

16. The method of claim 15, wherein said calculating and determining includes dividing the printable surface into stripes.

17. The method of claim 16, wherein said stripes are equal in width.

18. The method of claim 12, wherein said positioning includes setting said at least one printing head at a calculated distance and angle to said printable surface during the printing operation.

19. The method of claim 18, wherein said angle sets the printing head to be parallel to the tangent to the printable surface at each point.

20. The method of claim 12, wherein said rotation is one of rotation and translation.

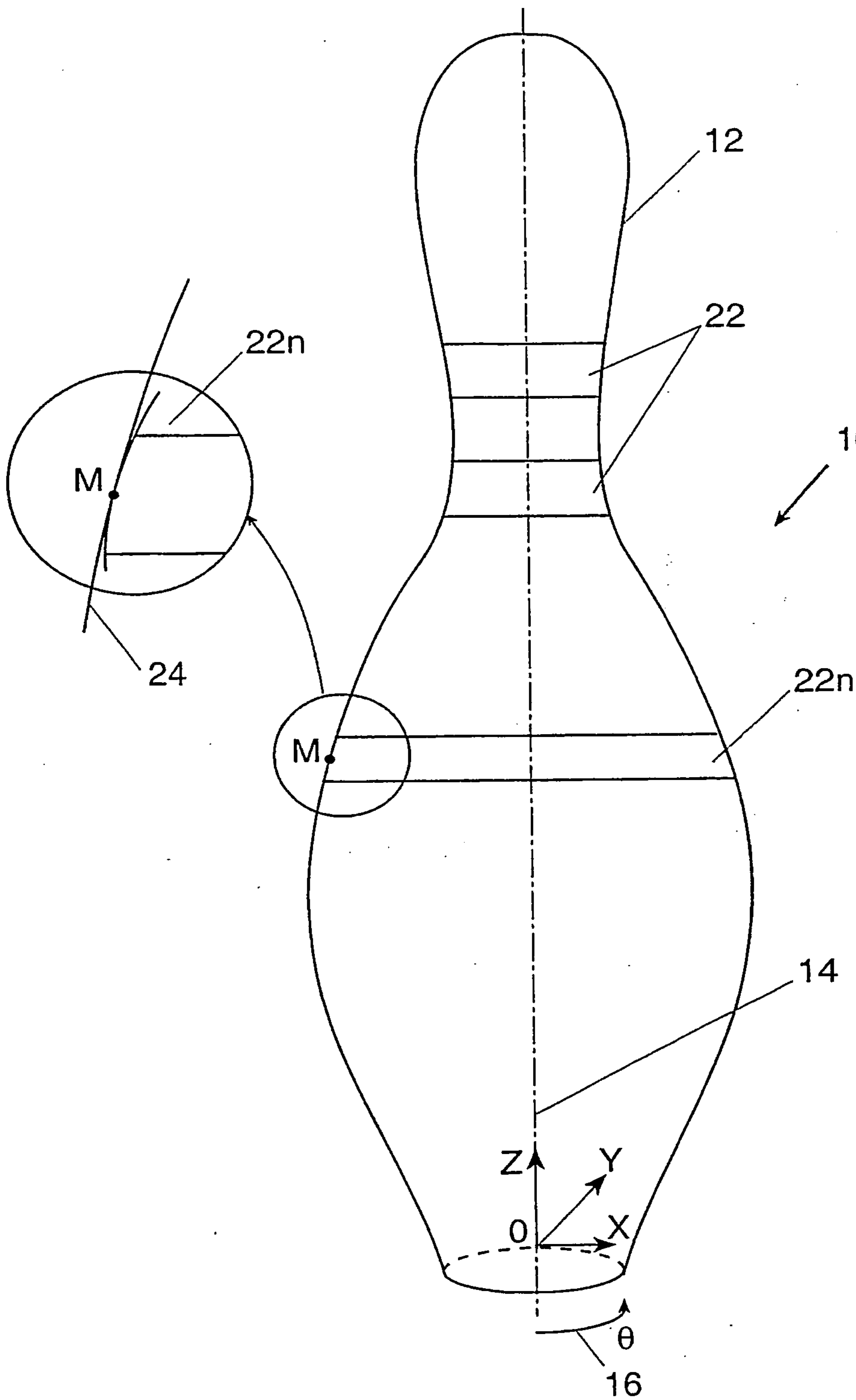
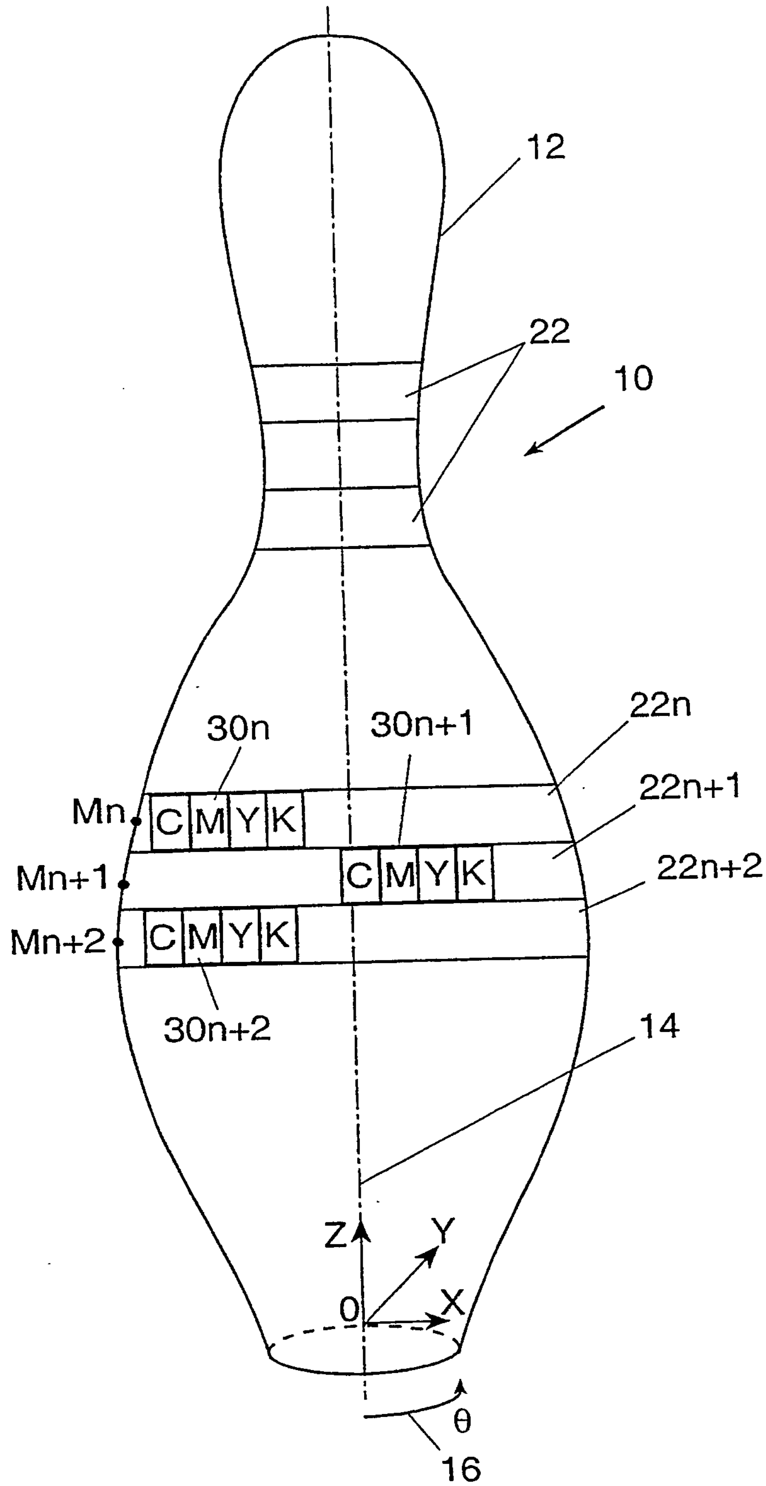


FIG. 1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Mn
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θ
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FIG. 2

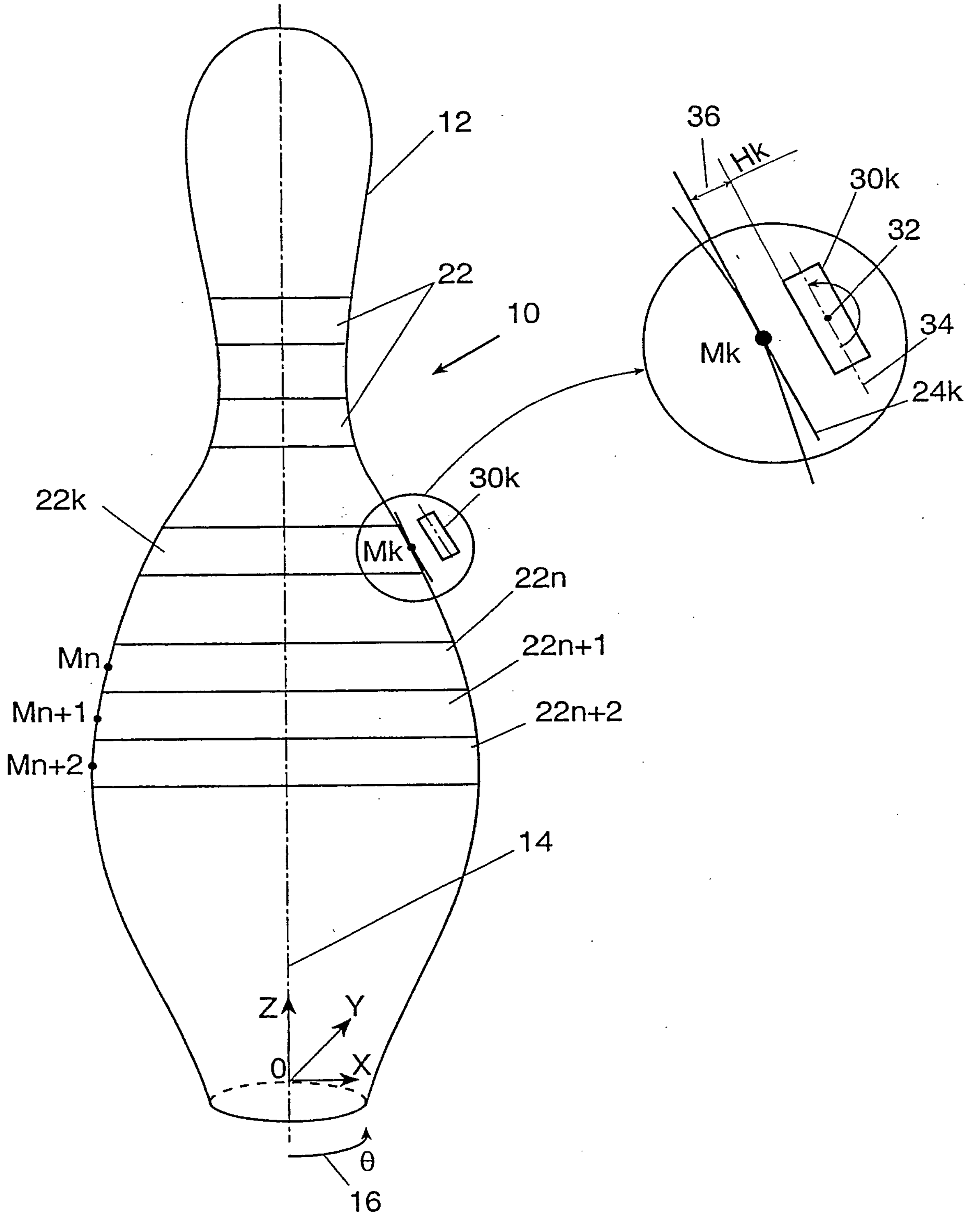
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FIG. 3

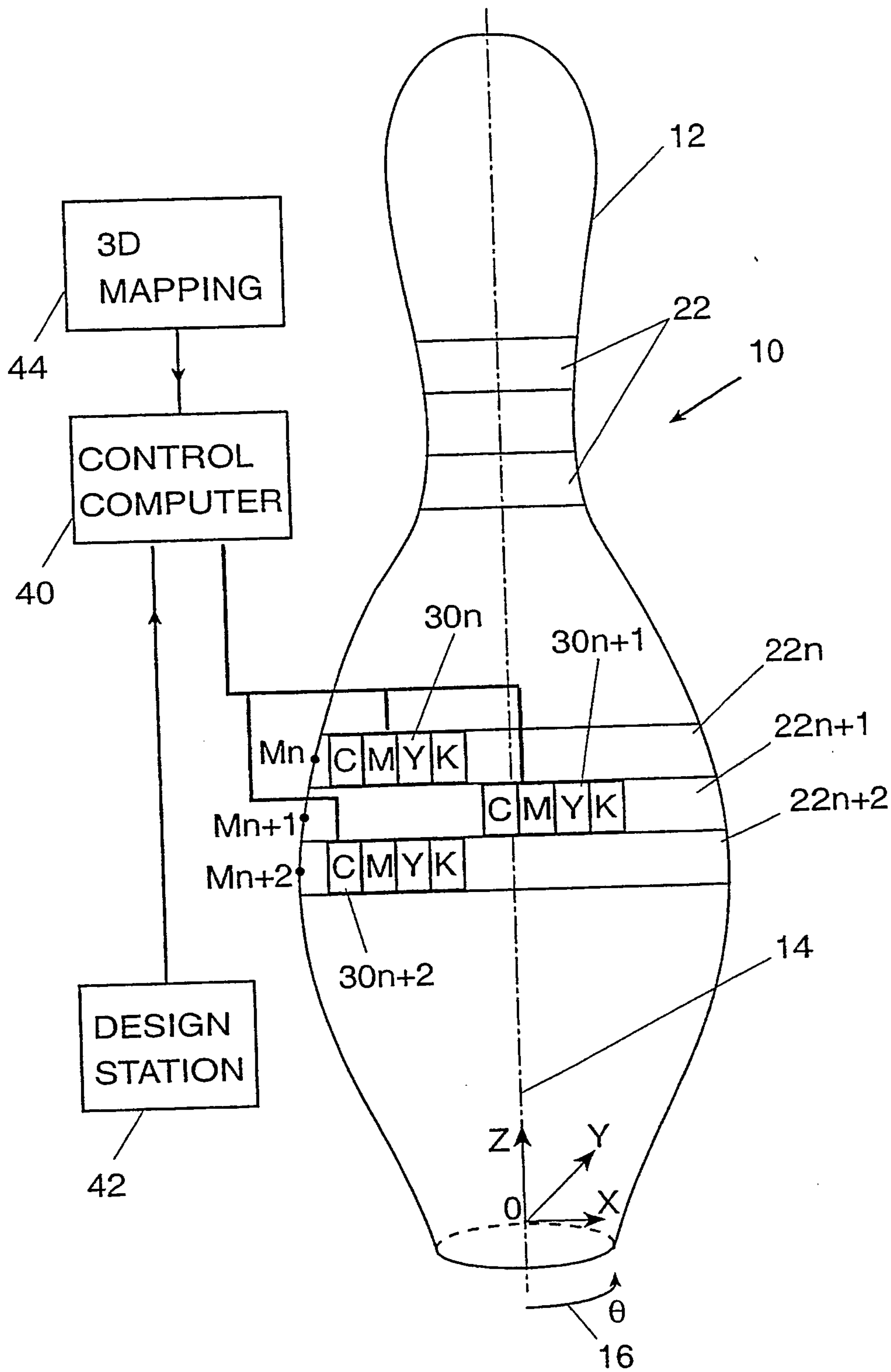
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FIG. 4

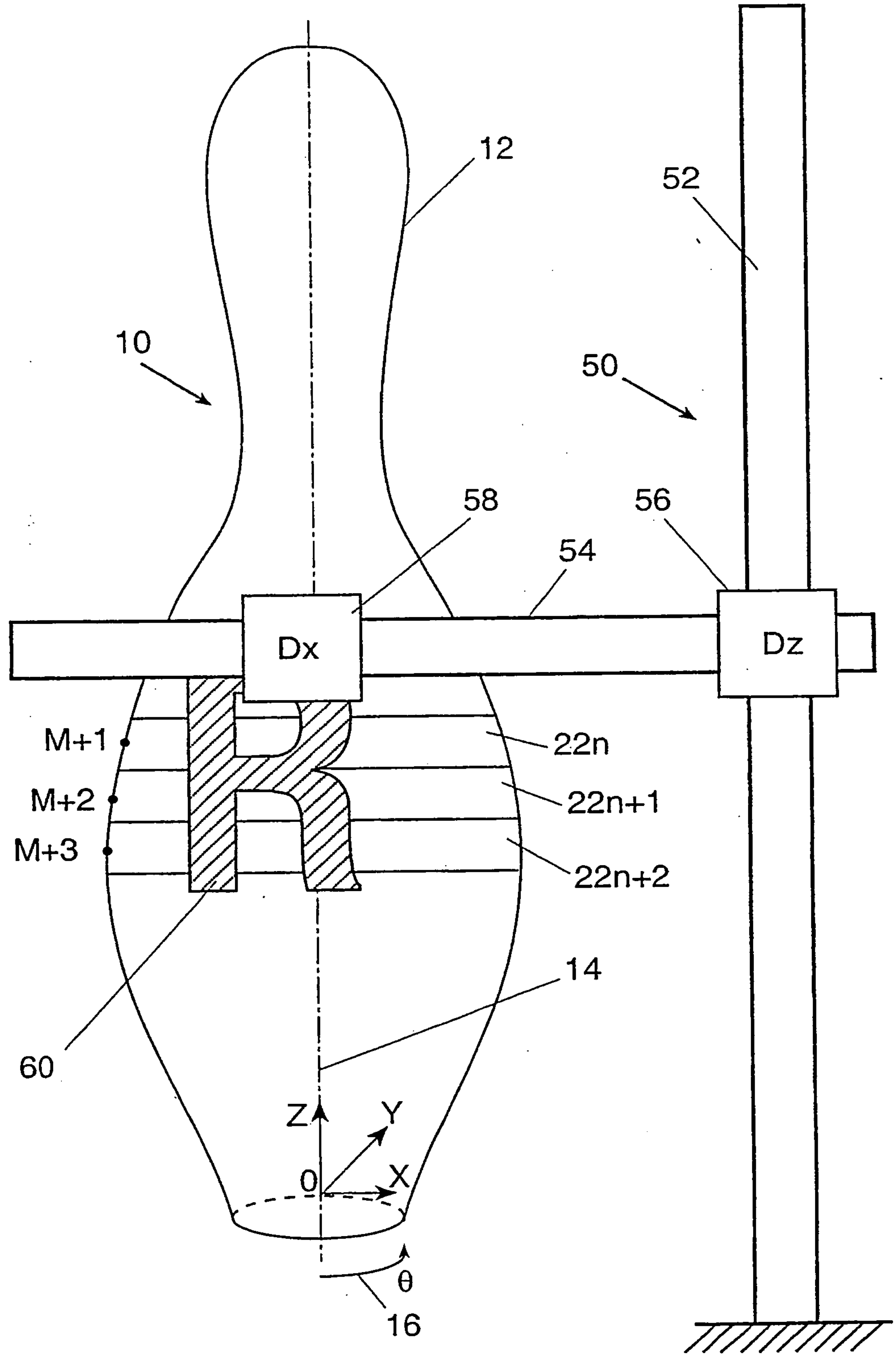

FIG. 5

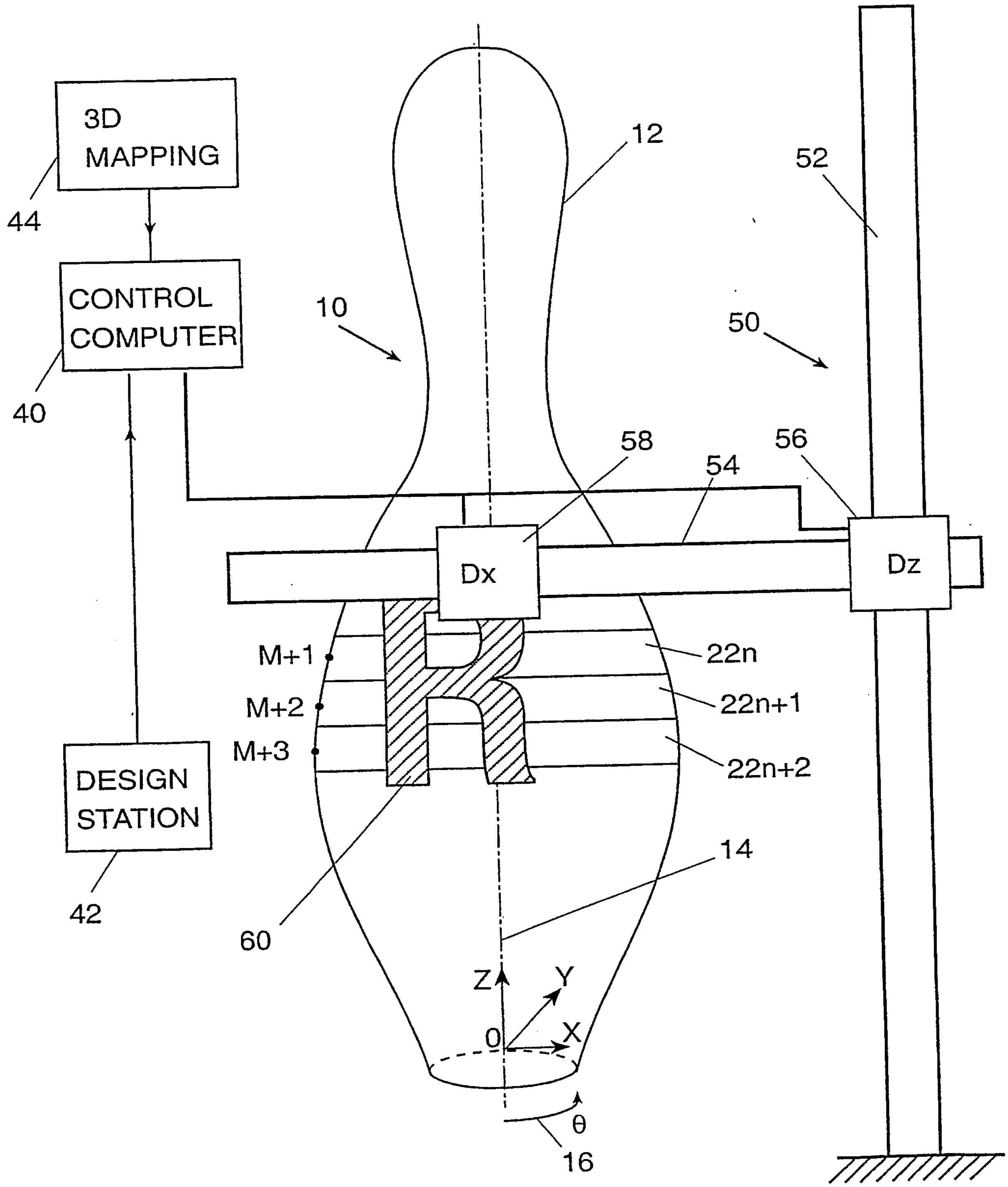
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FIG. 6

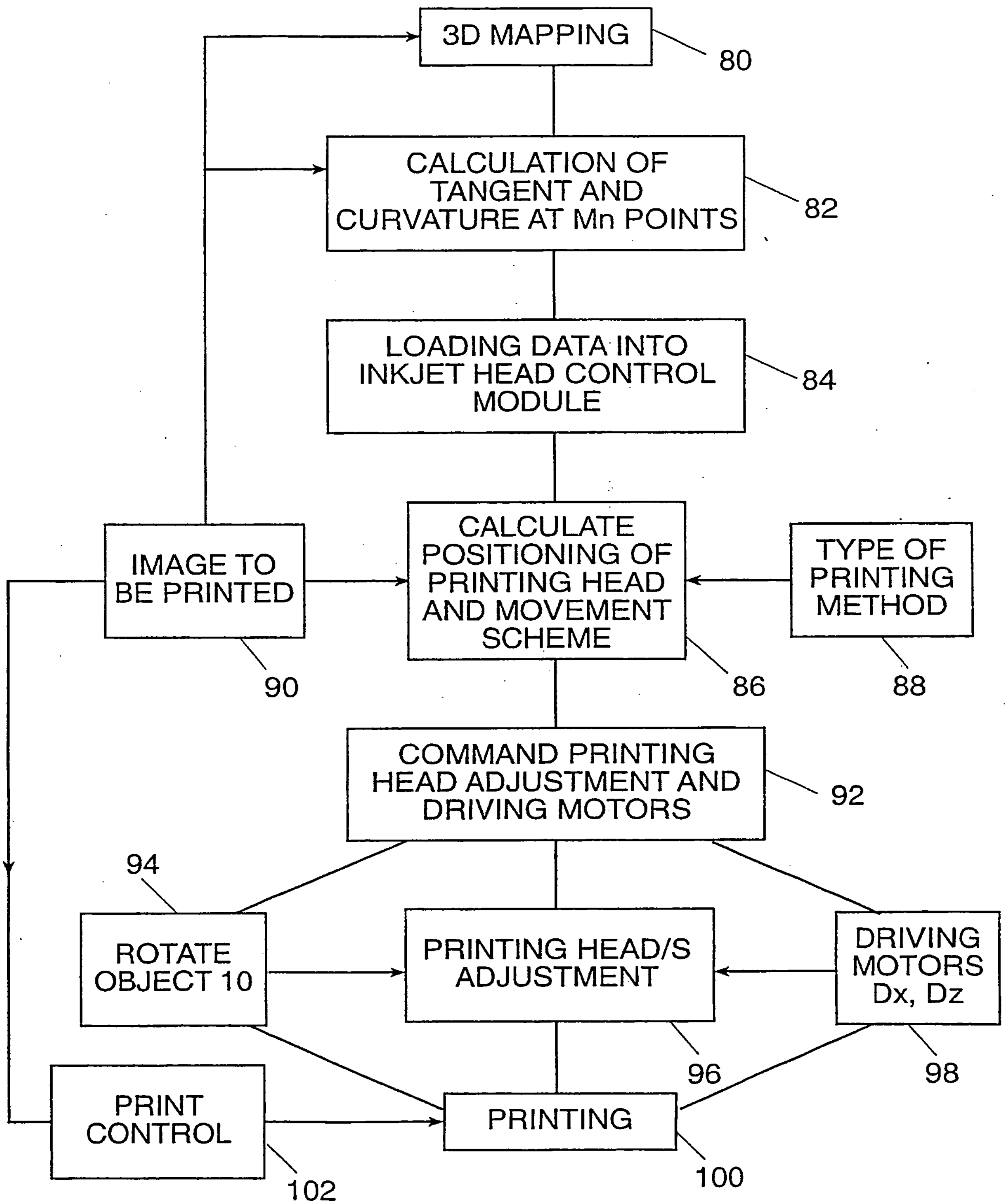
3D MAPPING
80
CALCULATION OF TANGENT AND CURVATURE AT Mn POINTS
82
LOADING DATA INTO INKJET HEAD CONTROL MODULE
84
IMAGE TO BE PRINTED
90
CALCULATE POSITIONING OF PRINTING HEAD AND MOVEMENT SCHEME
86
TYPE OF PRINTING METHOD
88
COMMAND PRINTING HEAD ADJUSTMENT AND DRIVING MOTORS
92
94
ROTATE OBJECT 10
PRINTING HEAD/S ADJUSTMENT
DRIVING MOTORS Dx, Dz
96
98
PRINT CONTROL
PRINTING
102
100

FIG. 7

INTERNATIONAL SEARCH REPORT

International Application No
PCT/IL 03/00047

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B41J3/407

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B41J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	EP 0 931 649 A (EASTMAN KODAK CO) 28 July 1999 (1999-07-28) paragraph '0013!; figure 1 paragraph '0019! ---	1-8,10, 11 12
X A	EP 1 225 053 A (DOLPHIN PACKAGING LTD) 24 July 2002 (2002-07-24) abstract paragraph '0035!; figure 3 paragraph '0039!; figure 4 ---	1-11 12
X A	PATENT ABSTRACTS OF JAPAN vol. 2000, no. 04, 31 August 2000 (2000-08-31) & JP 2000 006493 A (IKEGAMI TSUSHINKI CO LTD), 11 January 2000 (2000-01-11) abstract -----	1,3-6, 8-11 12

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
29 April 2003	14/05/2003

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/IL 03/00047

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 0931649	A	28-07-1999	EP 0931649 A2	28-07-1999
			JP 11314357 A	16-11-1999
			US 2001005942 A1	05-07-2001
			US 2001003871 A1	21-06-2001
EP 1225053	A	24-07-2002	EP 1225053 A2	24-07-2002
JP 2000006493	A	11-01-2000	NONE	